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DERWENT-ACC-NO: 1998-524111
DERWENT-WEEK: 199935

TITLE: Cutting tool with cemented carbide coating - includes base containing tungsten carbide group cemented carbide coated with carbide or carbonitride of titanium, zirconium or hafnium by chemical or physical vapour deposition

PATENT-ASSIGNEE: MITSUBISHI MATERIALS CORP (MITV)

PRIORITY-DATA: 1997JP-0026498 (February 10, 1997)

PATENT-FAMILY:

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APPLICATION-DATA:

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ABSTRACTED-PUB-NO: JP 10225804A
BASIC-ABSTRACT:

The tool consists of a bonding phase component of cobalt by about 5-15 wt.% and/or nickel in the base material comprising tungsten carbide having a beta-phase formation component. The beta-phase component comprises 1-10 wt.% with one or more of nitrides of titanium, tantalum, niobium, zirconium and hafnium, carbo-nitrides and two or more type of their solid solutions.

A beta-phase region is applied on flank to the same thickness whose average value is 5-30 microns. A growth restraining hard layer of beta-phase region comprises one type of single layer of Ti, Zr and Hf formed to an average thickness of 1-5 microns by chemical or physical vapour deposition.

One or more types of carbo-nitrides exist in the cutting edge and the flank, except on the base surface, the whole surface of growth restraining hard layer and the base of cutting edge. A titanium carbide, carbonitride or carboxide is formed by chemical vapour deposition. A hard surface layer comprising one type of a single layer of aluminium oxide and carbo-nitroxide or two or more types of multilayers obtained from surface coating with cemented carbides having an average thickness of 5-20 microns is obtained.

ADVANTAGE - Exhibits outstanding antiwear property. Retains machinability for long period.

ABSTRACTED-PUB-NO: JP 10225804A
EQUIVALENT-ABSTRACTS:

CHOSEN-DRAWING: Dwg.1/2

DERWENT-CLASS: L02 M13 M26 P54 P56
CPI-CODES: L02-J01B; M13-E02; M13-F; M26-B12;

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(54) **SURFACE-COATED CEMENTED CARBIDE CUTTING TOOL EXCELLENT IN CHIPPING RESISTANCE AND MANUFACTURE THEREFOR**

(57)Abstract:
PROBLEM TO BE SOLVED: To prevent the occurrence of chipping in a cutting edge even if intermittent cutting is performed by double cutting by similarly forming a hard coated layer in a specific average layer thickness by a chemical vapor deposition method and/or a physical vapor deposition method.
SOLUTION: In a vacuum, heat treatment of heating is performed on a base body on which at least a part in the thickness direction of a growth suppressing hard layer and a de-β phase zone of a cutting edge ridgeline part is removed by honing work, and a de-β phase zone having an average layer thickness of 5 to 30μm is formed in the substantially same thickness over a cutting face, the cutting edge ridgeline part and a flank relief in a base body surface part. Next, a hard coated layer composed of one kind of single layer or two or more kinds of plural layers among TiC, TiN, TiCN, TiCO and TiCNO and also Al2O3, is formed in an average layer thickness of 5 to 20μm over the whole surface of the base body by a chemical vapor deposition method and/or a physical vapor deposition method.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] It especially has the outstanding deficit-proof nature, therefore deficit-proof nature is required, for example, there is no generating of a deficit in a cutting edge, and this invention relates to the cutting tool made from surface coating cemented carbide (henceforth a coated carbide tool) which continues and demonstrates the outstanding cutting-ability ability at a long period of time, and its manufacturing method, when it uses for intermittence deep cuts of steel etc.
[0002]
[Description of the Prior Art] As generally a coated carbide tool being conventionally shown by outline process drawing by the organization which observed the cutting-edge longitudinal section of drawing 2 with the optical microscope, (a) The binder-phase formation component which makes Co and/or nickel a principal component : [5 - 15 % of the weight,] The nitride and charcoal nitride of Ti, Ta, Nb, Zr, and Hf (Hereafter, TiN, TaN, NbN, ZrN and reach, respectively and it HfN(s).) Furthermore TiCN, TaCN, NbCN, ZrCN, and HfCN show. And beta phase formation component which consists of 1 of two or more sorts of these solid solutions, or two sorts or more : The tungsten-carbide machine cemented carbide containing 1 - 10 % of the weight It consists of (it is only hereafter called cemented carbide). in the surface section A rake face, the cutting edge which a rake face and a flank cross -- it applies to the ridgeline section and a flank, and beta phase whose thickness is 5-30 micrometers does not exist -- Namely, the base in which the ** beta phase belt region where hardness is low exists as compared with the interior of a base is prepared. (b) Perform 0.03-0.3mm honing to the ridgeline section by the width of face seen from the rake face side, and it considers as a predetermined size. the cutting edge of the above-mentioned base -- (c) It continues all over the base after the above-mentioned honing. Carbide of Ti, To a nitride, a charcoal nitride, a carbonation object and a charcoal nitric oxide, and a pan, an aluminum oxide (Hereafter, TiC, TiN, TiCN, TiCO and reach, respectively and it TiCNO(s).) Furthermore, it is aluminum 2O3. The hard enveloping layer which consists of one sort of monolayers of inside [being shown], or two or more sorts of double layers It is also known that will be manufactured according to the basic process of (a) - (c) if it similarly forms at all by 5-20-micrometer average thickness in a chemical vapor deposition and/or a physical vapor deposition, and this coated carbide tool will be used for continuation cutting and intermittent cutting, such as steel and cast iron.
[0003]
[Problem(s) to be Solved by the Invention] On the other hand, FA-izing and highly-efficient-izing of cutting equipment in recent years are remarkable, and its demand to laborsaving and energy saving of cutting is also strong, and they are followed on this. cutting not to mention continuation cutting Although it is in the inclination intermittent cutting to be not only also possible, but for a cutting tool applicable also to deep cuts of high delivery, high slitting, etc. to be called for the above-mentioned conventional coated carbide tool -- setting -- the above-mentioned honing -- a cutting edge, since some or all of a ** beta phase belt region of the thickness direction is removed [of the ridgeline section] a cutting edge -- the thickness of the ** beta phase belt region of the ridgeline section, since this becomes that there is nothing thinly relatively as compared with the thickness of the ** beta phase belt region in a rake face and a flank for example, the case where this is used for intermittence deep cuts of steel -- especially -- a cutting edge -- the present condition is being easy to generate a chip in the ridgeline section, and being unable to present practical use
[0004]
[Means for Solving the Problem] Then, it faces that this invention person etc. manufactures a coated carbide tool as a result of inquiring from the above viewpoints paying attention to the above-mentioned conventional coated carbide tool to measure the deficit-proof disposition top of this. As being shown by outline process drawing by the organization which observed the cutting-edge longitudinal section of drawing 1 with the optical microscope, The binder-phase formation component which makes Co and/or nickel a principal component : 5 - 15 % of the weight, To TiN, TaN, NbN, ZrN and HfN, and a pan, TiCN, beta phase formation component which consists of 1 of TaCN, NbCN, ZrCN, HfCN(s), and two or more sorts of these solid solutions, or two sorts or more : It consists of cemented carbide containing 1 - 10 % of the weight. In and the organization (it is the same hereafter) which observed the cutting-edge longitudinal section with the optical microscope in the surface section a rake face and a cutting edge -- it applies to the ridgeline section and a flank, and beta phase whose thickness is 5-30 micrometers does not exist -- On the front face of a base on which the ** beta phase belt region where hardness is low exists as compared with the interior of a base, beforehand Ti, The carbide and the charcoal nitride (it TiC(s) hereafter, respectively) of Zr and Hf The hard layer which consists of ZrC and HfC, one sort of monolayers of inside [that TiCN, ZrCN, and HfCN show further], or two or more sorts of double

layers in the state where it formed by 1-5-micrometer average thickness by the chemical vapor deposition and/or the physical vapor deposition the width of face seen from the rake face side -- 0.03-0.3mm honing -- giving -- this honing -- a cutting edge -- the above-mentioned hard layer of the ridgeline section -- and -- the same -- a cutting edge, since some or all of a ** beta phase belt region of the thickness direction is removed [of the ridgeline section] a cutting edge, although the thickness of the ** beta phase belt region of the ridgeline section becomes that there is this [no] thinly relatively as compared with the thickness of the ** beta phase belt region in a rake face and a flank beta phase in the base surface section of the ridgeline section decomposes. if this is heated in temperature of 1350-1500 degrees C among vacuum atmosphere -- a cutting edge -- Formation of the thickness direction of the ** beta phase belt region in the base surface section of the ridgeline section advances. the nitrogen (N) component which is a constituent of this emits to vacuum atmosphere -- having -- this -- a cutting edge -- On the other hand, formation (thick-izing) of the further thickness direction of the ** beta phase belt region in the surface section of a rake face and a flank To the well from which discharge in the vacuum atmosphere of N component is prevented by the above-mentioned hard layer which remained without being removed by the above-mentioned honing, a line crack since there is nothing, by carrying out predetermined-time maintenance to the aforementioned heating temperature It applies to the ridgeline section and a flank, and the ** beta phase belt region of the same thickness comes to be formed substantially. the base surface section -- a rake face and a cutting edge -- in this state If the above-mentioned hard enveloping layer is similarly formed by 5-20-micrometer average thickness in a chemical vapor deposition and/or a physical vapor deposition, the manufactured coated carbide tool The research result that the deficit-proof nature which was excellent with the ** beta phase belt region which exists in the base surface section by the same thickness substantially comes to be shown was obtained.

[0005] This invention is made based on the above-mentioned research result (a). The binder-phase formation component which makes Co and/or nickel a principal component : [5 - 15 % of the weight,] To TiN, TaN, NbN, ZrN and HfN, and a pan, TiCN, beta phase formation component which consists of 1 of TaCN, NbCN, ZrCN, HfCN(s), and two or more sorts of these solid solutions, or two sorts or more : The cemented carbide containing 1 - 10 % of the weight, The binder-phase formation component which makes Co and/or nickel a principal component desirably : 5 - 15 % of the weight, To TiN, TaN, NbN, ZrN and HfN, and a pan, TiCN, beta phase formation component which consists of 1 of TaCN, NbCN, ZrCN, HfCN(s), and two or more sorts of these solid solutions, or two sorts or more : 1 - 10 % of the weight is contained. It consists of cemented carbide which has the composition which the remainder becomes from a tungsten carbide (WC shows hereafter) and an unescapable impurity. and the cutting edge at which a rake face, a rake face, and a flank cross the surface section -- it applies to the ridgeline section and a flank, and beta phase whose thickness is 5-30 micrometers does not exist -- The base in which the ** beta phase belt region where hardness is low exists as compared with the interior of a base is prepared (b). On the front face of the above-mentioned base TiC, ZrC and HfC, and the growth suppression hard layer of a ** beta phase belt region that consists of one sort of monolayers of TiCN, ZrCN, and the HfCN(s) or two or more sorts of double layers further are formed by 1-5-micrometer average thickness in a chemical vapor deposition and/or a physical vapor deposition. (c) -- the cutting edge of the base of the above-mentioned growth suppression hard stratification -- the ridgeline section -- honing (usually) Give 0.03-0.3mm by the width of face seen from the rake face side, and it considers as a predetermined size. (d) To the base from which a part of thickness direction [at least] of the growth suppression hard layer of the ridgeline section and a ** beta phase belt region was removed, heating in temperature of 1350-1500 degrees C is heat-treated among a vacuum. the above-mentioned honing -- a cutting edge -- the cutting edge direct made into vacuum atmosphere -- denitrification from the base in the ridgeline section to vacuum atmosphere -- carrying out -- a cutting edge -- by aiming at formation of the thickness direction of the ** beta phase belt region of only the ridgeline section Apply to the ridgeline section and a flank and it is substantially made the same thickness. the base surface section -- a rake face and a cutting edge -- Average thickness forms the ** beta phase belt region which is 5-30 micrometers (e). It continues all over the base after the above-mentioned heat treatment. It is aluminum 2O3 to TiC, TiN, TiCN, TiCO and TiCNO, and a pan. The hard enveloping layer which consists of one sort of inner monolayers, or two or more sorts of double layers Similarly form by 5-20-micrometer average thickness in a chemical vapor deposition and/or a physical vapor deposition. How to manufacture a coated carbide tool according to the basic process of (a) - (e) above, And it was manufactured by the above-mentioned method (a). The binder-phase formation component which makes Co and/or nickel a principal component : [5 - 15 % of the weight,] To TiN, TaN, NbN, ZrN and HfN, and a pan, TiCN, beta phase formation component which consists of 1 of TaCN, NbCN, ZrCN, HfCN(s), and two or more sorts of these solid solutions, or two sorts or more : The cemented carbide containing 1 - 10 % of the weight, The binder-phase formation component which makes Co and/or nickel a principal component desirably : 5 - 15 % of the weight, To TiN, TaN, NbN, ZrN and HfN, and a pan, TiCN, beta phase formation component which consists of 1 of TaCN, NbCN, ZrCN, HfCN(s), and two or more sorts of these solid solutions, or two sorts or more : 1 - 10 % of the weight is contained. Apply to the ridgeline section and a flank and it is substantially made the same thickness. the surface section of the base which consisted of cemented carbide which has the composition which the remainder becomes from WC and an unescapable impurity -- a rake face and a cutting edge -- the interior of the base in which beta phase whose average thickness is 5-30 micrometers does not exist -- comparing -- the ** beta phase belt region where hardness is low -- existing -- (b) again -- the cutting edge on a base front face -- to the rake face and flank except the ridgeline section Were formed by 1-5-micrometer average thickness in the chemical vapor deposition and/or the physical vapor deposition. TiC, ZrC and HfC, and the growth suppression hard layer of a ** beta phase belt region that consists of one sort of monolayers of TiCN, ZrCN, and the HfCN(s) or two or more sorts of double layers further exist. (c) It continues all over the ridgeline section. further -- a growth suppression hard layer and a base -- a cutting edge -- TiC similarly formed in the chemical vapor deposition and/or the physical vapor deposition, It is aluminum 2O3 to TiN, TiCN, TiCO and TiCNO, and a pan. The hard enveloping layer which consists of one sort of inner monolayers or two or more

sorts of double layers has the feature in a coated carbide tool with the cross-section structure which exists by the average thickness which is 5-20 micrometers.

[0006] Below, in the coated carbide tool of this invention, and its manufacturing method, the average thickness of the growth suppression hard layer of composition of a base, a ** beta phase belt region, and a ** beta phase belt region and a hard enveloping layer and the reason for having carried out numerical limitation of the heat treatment temperature further as above-mentioned are explained.

[0007] (1) although the content binder-phase formation component of the binder-phase formation component of a base had the operation which it promotes and has [operation] a degree of sintering and raises the intensity of a base, when the effect of a request [at less than 5 % of the weight] of the content to the aforementioned operation was not acquired but the content, on the other hand, exceeded 15 % of the weight, since abrasion resistance came to have fallen rapidly, the content was determined as 5 - 15 % of the weight

[0008] (2) although the content beta phase formation component of beta phase formation component of a base had the operation which raises the hardness of a base and raises abrasion resistance, when the effect of a request [at less than 1 % of the weight] of the content to the aforementioned operation was not acquired but the content, on the other hand, exceeded 10 % of the weight, since deficit-proof nature came to have fallen, the content was determined as 1 - 10 % of the weight

[0009] (3) Although there is an operation which the average thickness above of the ** beta phase belt region of the base surface section passes, and beta phase does not exist [operation] in a ** beta phase belt region substantially, but it comes to have operation] low hardness relatively as compared with the interior of a base by this, and raises deficit-proof nature Since it became easy to generate plastic deformation in a base, a cutting edge carried out partial wear as a result and it came to have resulted in the use life for a short time when the average thickness could not secure desired deficit-proof nature in less than 5 micrometers but the average thickness exceeded 30 micrometers on the other hand, the average thickness was determined as 5-30 micrometers.

[0010] (4) average **** of a growth suppression hard layer -- in less than 1 micrometer, a desired effect was not acquired by growth suppression of a ** beta phase belt region [in / the rake face and flank of the base surface section / in the average thickness], but on the other hand, since the average thickness to 5 micrometers was enough as the growth suppression effect of the aforementioned ** beta phase belt region, it determined the average thickness as 1-5 micrometers

[0011] (5) average **** of a hard enveloping layer -- when the average thickness could not secure the abrasion resistance which excelled [micrometers / less than 5] in the request but the average thickness exceeded 20 micrometers on the other hand, deficit-proof nature fell and the average thickness was determined as 5-20 micrometers from the bird clapper that it is easy to generate a deficit, a chipping (minute chip), etc. in a cutting edge

[0012] (6) the degree of ******** -- the temperature -- less than 1350 degrees C -- a cutting edge -- when formation of the ** beta phase belt region in the ridgeline section was slow, it was not practical and the temperature exceeded 1500 degrees C on the other hand, the base softened and the temperature was determined as 1350-1500 degrees C from the bird clapper that it is easy to cause the deformation leading to short-lived-izing

[0013]

[Embodiments of the Invention] Below, an example explains this invention concretely. The TiC powder which all has a mean particle diameter within the limits of 1-3 micrometers as raw material powder, TaC powder, ZrC powder, HfC powder, TiN powder, ZrN powder, TiCN powder, C (Ti, W) (by the weight ratio) the following -- the same -- TiC/WC=30/70 powder and C (Ta, Nb) (TaC/NbC=90/10) powder -- CN (TiC/TiN/WC=24/20/56) powder, (Ti, W) Co powder, nickel powder, VC powder, and Cr 3C2 Powder is prepared. Blend these raw material powder with the combination composition shown in Table 1, and wet blending is carried out with a ball mill for 72 hours. After drying, press forming is carried out to the green compact of a predetermined configuration. this green compact The inside of the vacuum of 0.05torr(s), Cemented carbide base A-F with the throwaway tip configuration of ISO specification 120408 was manufactured, respectively by carrying out vacuum sintering to the predetermined temperature within the limits of 1380-1450 degrees C on condition that maintenance for 1 hour. When the average thickness of the ** beta phase belt region of the base surface section was measured based on the optical microscope photograph of the cutting-edge longitudinal section of the above-mentioned base A-F (it is below the same), the result shown in Table 1 was shown.

[0014] Next, a chemical vapor deposition is used for the front face of the above-mentioned base A-F. on condition that usual After forming the growth suppression hard layer of the ** beta phase belt region of the composition shown in Table 2, respectively, and average thickness, Honing of the amount of processings similarly shown in Table 2 is performed, and the result shown in Table 2 when the average thickness of the ** beta phase belt region of the base surface section is measured at this time is shown. subsequently It heat-treats on condition that time maintenance of predetermined of 0.5 - 2 hours within the limits to the predetermined temperature in the vacuum of the predetermined pressure of 0.01 - 0.1torr within the limits, and within the limits of 1370-1470 degrees C. When the average thickness of the ** beta phase belt region of the base surface section is similarly measured at this time, the result shown in Table 3 is shown, and a chemical vapor deposition is used still the more nearly same. on condition that usual this invention methods 1-12 which consist of forming the hard enveloping layer of the composition shown in Table 3, respectively and average thickness were enforced, and this invention coated carbide tools 1-12 were manufactured, respectively. Moreover, for the comparative purpose, except not performing heat treatment for formation of the growth suppression hard layer of a ** beta phase belt region, and ** beta phase belt region formation, conventional methods 1-12 were performed on the same conditions, and coated carbide tools 1-12 were conventionally manufactured, respectively as shown in Tables 5 and 6.

[0015] various kinds of coated carbide tools obtained as a result -- the square bar of **-ed material:SCN439 (hardness : Hb230), and cutting-speed:100 m/min -- sending -- : -- 0.375 mm/rev, it cut deeply, the dry type quantity delivery intermittent-cutting examination of steel was performed on condition that :3mm and cutting-time:10-minute **, and the width of flank wear land of a cutting edge was measured This measurement result was shown in Table 6.

[0016]

[Table 1]

種別		配合組成（重量%）			脱β相帯域の平均層厚（μm）		
		結合相形成成分	β相形成成分	WC	すくい面	切刃稜線部	逃げ面
基体	A	Co：6	TiC：4, TaC：1, TiN：1	残	7	4	8
	B	Co：7, Cr_3C_2：0.2	TaC：3, ZrC：1, ZrN：1.5	残	22	18	22
	C	Co：8.5	TiC：1.5, TaC：3, TiCN：2	残	30	12	31
	D	Co：10, Ni：3, VC：0.1	TiC：2, (Ta, Nb) C：5 TiN：1.5	残	17	5	17
	E	Co：9	ZrC：2, HfC：0.5, (Ti, W) CN：5	残	25	20	25
	F	Co：13, Ni：1, Cr_3C_2：0.4	(Ti, W) C：5, (Ta, Nb) C：2, TiN：2	残	14	6	15

[0017]

[Table 2]

種別		基体記号	成長抑止硬質層の組成（括弧内は平均層厚：μm）			ホーニング加工幅（mm）		ホーニング加工後の脱β相帯域の平均層厚（μm）		
			第1層	第2層	第3層	すくい面側	逃げ面側	すくい面	切刃稜線部	逃げ面
本発明法	1	A	TiC (3)	−	−	0.04	0.03	7	1	8
	2	A	TiC (1)	ZrCN (2)	−	0.07	0.07	7	0	8
	3	B	TiCN (5)	−	−	0.15	0.04	22	0	22
	4	B	TiC (1)	HfC (1)	−	0.08	0.08	22	2	22
	5	C	HfCN (1)	TiC (3)	−	0.20	0.07	30	0	31
	6	C	ZrC (2)	HfC (1)	−	0.15	0.05	30	0	31
	7	D	TiC (2)	TiCN (1)	−	0.07	0.06	17	1	17
	8	D	TiC (0.5)	TiCN (0.5)	TiC (1)	0.06	0.06	17	3	17
	9	E	TiC (2)	−	−	0.18	0.07	25	2	25
	10	E	ZrC (1)	−	−	0.08	0.08	26	4	25
	11	F	HfCN (1.5)	−	−	0.05	0.05	14	0	15
	12	F	TiCN (2)	−	−	0.09	0.09	14	0	15

[0018]

[Table 3]

種別		熱処理後の脱β相帯域の平均層厚（μm）			硬質被覆層（括弧内は平均層厚：μm）						
		すくい面	切刃稜線部	逃げ面	第1層	第2層	第3層	第4層	第5層	第6層	第7層
本発明法	1	8	7	8	TiN (0. 1)	TiCN (7)	Al_2O_3 (1. 5)	TiN (0. 2)	－	－	－
	2	9	8	9	TiC (1)	TiCN (10)	TiCNO (0. 5)	Al_2O_3 (1)	TiN (0. 1)	－	－
	3	23	23	23	TiN (0. 2)	TiCN (5)	TiC (2)	TiCO (0. 5)	Al_2O_3 (2)	TiC (0. 1)	TiN (0. 1)
	4	22	21	22	TiCN (2)	TiC (1)	Al_2O_3 (0. 5)	－	－	－	－
	5	30	28	30	TiN (0. 2)	TiC (2)	TiCN (5)	TiCO (0. 5)	Al_2O_3 (3)	TiN (0. 2)	－
	6	30	27	30	TiN (0. 2)	TiCN (10)	TiCNO (0. 1)	Al_2O_3 (2)	－	－	－
	7	17	17	17	TiN (1)	TiCN (5)	TiCO (0. 2)	Al_2O_3 (5)	TiCN (0. 2)	TiN (0. 5)	－
	8	18	16	18	TiC (0. 5)	TiCN (4)	TiN (1)	Al_2O_3 (3. 5)	TiN (0. 5)	－	－
	9	25	24	25	TiCN (5)	TiC (3)	TiCO (1)	Al_2O_3 (5)	TiN (0. 1)	－	－
	10	26	24	26	TiC (3)	TiN (2)	TiC (2)	TiN (2)	－	－	－
	11	15	14	15	TiCN (2)	TiC (2)	TiCO (0. 1)	Al_2O_3 (7)	－	－	－
	12	14	14	14	TiN (0. 2)	TiCN (12)	TiCNO (0. 1)	Al_2O_3 (0. 5)	TiCN (0. 1)	TiN (0. 1)	－

[0019]
[Table 4]

種別		基体記号	成長抑止硬質層の組成（括弧内は平均層厚：μm）			ホーニング加工幅（mm）		ホーニング加工後の脱β相帯域の平均層厚（μm）		
			第1層	第2層	第3層	すくい面側	逃げ面側	すくい面	切刃稜線部	逃げ面
従来法	1	A	－	－	－	0. 04	0. 03	7	2	8
	2	A	－	－	－	0. 07	0. 07	7	0	8
	3	B	－	－	－	0. 15	0. 04	22	0	22
	4	B	－	－	－	0. 08	0. 08	22	2	22
	5	C	－	－	－	0. 20	0. 07	30	0	31
	6	C	－	－	－	0. 15	0. 05	30	0	31
	7	D	－	－	－	0. 07	0. 08	17	1	17
	8	D	－	－	－	0. 06	0. 06	17	4	17
	9	E	－	－	－	0. 18	0. 07	25	2	25
	10	E	－	－	－	0. 08	0. 08	26	4	25
	11	F	－	－	－	0. 05	0. 05	14	0	15
	12	F	－	－	－	0. 09	0. 09	14	0	15

[0020]

[Table 5]

種別		熱処理後の脱β相帯域の平均層厚(μm)			硬質被覆層 (括弧内は平均層厚：μm)						
		すくい面	切刃稜線部	逃げ面	第1層	第2層	第3層	第4層	第5層	第6層	第7層
従来法	1	-	-	-	TiN (0.1)	TiCN (7)	Al_2O_3 (1.5)	TiN (0.2)	-	-	-
	2	-	-	-	TiC (1)	TiCN (10)	TiCNO (0.5)	Al_2O_3 (1)	TiN (0.1)	-	-
	3	-	-	-	TiN (0.2)	TiCN (5)	TiC (2)	TiCO (0.5)	Al_2O_3 (2)	TiC (0.1)	TiN (0.1)
	4	-	-	-	TiCN (2)	TiC (1)	Al_2O_3 (0.5)	-	-	-	-
	5	-	-	-	TiN (0.2)	TiC (2)	TiCN (5)	TiCO (0.5)	Al_2O_3 (3)	TiN (0.2)	-
	6	-	-	-	TiN (0.2)	TiCN (10)	TiCNO (0.1)	Al_2O_3 (2)	-	-	-
	7	-	-	-	TiN (1)	TiCN (5)	TiCO (0.2)	Al_2O_3 (5)	TiCN (0.2)	TiN (0.5)	-
	8	-	-	-	TiC (0.5)	TiCN (4)	TiN (1)	Al_2O_3 (3.5)	TiN (0.5)	-	-
	9	-	-	-	TiCN (5)	TiC (3)	TiCO (1)	Al_2O_3 (5)	TiN (0.1)	-	-
	10	-	-	-	TiC (3)	TiN (2)	TiC (2)	TiN (2)	-	-	-
	11	-	-	-	TiCN (2)	TiC (2)	TiCO (0.1)	Al_2O_3 (7)	-	-	-
	12	-	-	-	TiN (0.2)	TiCN (12)	TiCNO (0.1)	Al_2O_3 (0.5)	TiCN (0.1)	TiN (0.1)	-

[0021]

[Table 6]

種別		逃げ面摩耗幅 (mm)	種別		逃げ面摩耗幅 (mm)
本発明被覆超硬工具	1	22.2	従来被覆超硬工具	1	3.5分で切刃欠損のため寿命
	2	24.8		2	4.2分で切刃欠損のため寿命
	3	19.7		3	2.1分で切刃欠損のため寿命
	4	15.6		4	1.9分で切刃欠損のため寿命
	5	29.8		5	5.4分で切刃欠損のため寿命
	6	26.3		6	3.0分で切刃欠損のため寿命
	7	25.2		7	4.4分で切刃欠損のため寿命
	8	21.5		8	2.9分で切刃欠損のため寿命
	9	20.5		9	1.1分で切刃欠損のため寿命
	10	21.2		10	2.3分で切刃欠損のため寿命
	11	26.8		11	5.8分で切刃欠損のため寿命
	12	28.9		12	4.6分で切刃欠損のため寿命

[0022]

[Effect of the Invention] this invention coated carbide tools 1-12 manufactured by this invention methods 1-12 as shown in Tables 2-6 As opposed to the abrasion resistance which it applied to the ridgeline section and the flank, and the ** beta phase belt region

of the same thickness existed substantially, and the high delivery intermittent cutting of steel does not have generating of a deficit in a cutting edge, either, and excelled [cutting edge] in it by this being shown any -- the base surface section -- a rake face and a cutting edge -- conventional coated-carbide-tool 1-12 manufactured by conventional methods 1-12 -- setting -- especially -- the cutting edge of the base surface section -- it is clear for a ** beta phase belt region not to exist in the ridgeline section, and for generating of a deficit not to be avoided by the cutting edge by cutting on the above-mentioned severe conditions owing to this, but to result in a use life comparatively for a short time As mentioned above, even if the coated carbide tool which is in the state which held the outstanding abrasion resistance according to the method of this invention, and could manufacture the coated carbide tool which was excellent in deficit-proof nature, therefore was obtained as a result performs intermittent cutting used as cutting on severer conditions with deep cuts, there is no generating of a deficit in a cutting edge, and it continues and demonstrates the outstanding cutting-ability ability at a long period of time not to mention continuation cutting and the intermittent cutting in the usual conditions.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is outline process drawing showing this invention method.
[Drawing 2] It is outline process drawing showing the conventional method.

[Translation done.]

CLAIMS

[Claim(s)]
[Claim 1] The binder-phase formation component which makes Co and/or nickel a principal component : 5 - 15 % of the weight, beta phase formation component which consists of 1 of the nitride of Ti, Ta, Nb, Zr, and Hf, charcoal nitrides, and two or more sorts of these solid solutions, or two sorts or more : in the surface section of the base which consisted of tungsten-carbide machine cemented carbide containing 1 - 10 % of the weight Apply to the ridgeline section and a flank and it is substantially made the same thickness. the cutting edge which a rake face, a rake face, and a flank cross at the organization which observed the cutting-edge longitudinal section with the optical microscope -- the ** beta phase belt region where beta phase whose average thickness is 5-30 micrometers does not exist -- existing -- moreover, the cutting edge on a base front face -- to the rake face and flank except the ridgeline section Were formed by 1-5-micrometer average thickness in the chemical vapor deposition and/or the physical vapor deposition. The growth suppression hard layer of the ** beta phase belt region which consists of one sort of monolayers of the carbide of Ti, Zr, and Hf and the charcoal nitrides or two or more sorts of double layers exists. furthermore, a growth suppression hard layer and a base -- a cutting edge -- it continued all over the ridgeline section and, similarly was formed in the chemical vapor deposition and/or the physical vapor deposition -- The carbide, the nitride, the charcoal nitride, carbonation object, and charcoal nitric oxide of Ti, The cutting tool made from surface coating cemented carbide which was excellent in the deficit-proof nature characterized by constituting from surface coating cemented carbide which exists by the average thickness whose hard enveloping layer which furthermore consists of one sort of monolayers of the aluminum oxides or two or more sorts of double layers is 5-20 micrometers.
[Claim 2] The binder-phase formation component which makes Co and/or nickel a principal component : (a) 5 - 15 % of the weight, beta phase formation component which consists of 1 of the nitride of Ti, Ta, Nb, Zr, and Hf, charcoal nitrides, and two or more sorts of these solid solutions, or two sorts or more : It consists of tungsten-carbide machine cemented carbide containing 1 - 10 % of the weight. In the surface section, the cutting-edge longitudinal section in the organization which observed with the optical microscope And a rake face, The base in which the ridgeline section and the ** beta phase belt region where it applies to a flank and beta phase whose thickness is 5-30 micrometers does not exist exist is prepared. the cutting edge which a rake face and a flank cross -- (b) The growth suppression hard layer of the ** beta phase belt region which consists of one sort of monolayers of the carbide of Ti, Zr, and Hf and the charcoal nitrides or two or more sorts of double layers is formed in the front face of the above-mentioned base by 1-5-micrometer average thickness in a chemical vapor deposition and/or a physical vapor deposition. (c) Perform honing to the ridgeline section and it considers as a predetermined size. the cutting edge of the base of the above-mentioned growth suppression hard stratification -- (d) To the base from which a part of growth suppression hard layer of the ridgeline section and ** beta phase belt region [at least] were removed, heating in temperature of 1350-1500 degrees C is heat-treated among a vacuum. the above-mentioned honing -- a cutting edge -- the cutting edge direct made into vacuum atmosphere -- denitrification from the base in the ridgeline section to vacuum atmosphere -- carrying out -- a cutting edge -- by aiming at formation of the thickness direction of the ** beta phase belt region of only the ridgeline section Apply to the ridgeline section and a flank and it is substantially made the same thickness. the base surface section -- a rake face and a cutting edge -- Average thickness forms the ** beta phase belt region which is 5-30 micrometers (e). It continues all over the base after the above-mentioned heat treatment. The carbide of Ti, a nitride, a charcoal nitride, a carbonation object and a charcoal nitric oxide, and the hard enveloping layer that consists of one sort of monolayers of the aluminum oxides, or two or more sorts of double layers further The manufacturing method of the cutting tool made from surface coating cemented carbide which was excellent in the deficit-proof nature characterized by the bird clapper from the basic process of (a) - (e) if it similarly forms at all by 5-20-micrometer average thickness in a chemical vapor deposition and/or a physical vapor deposition.

[Translation done.]

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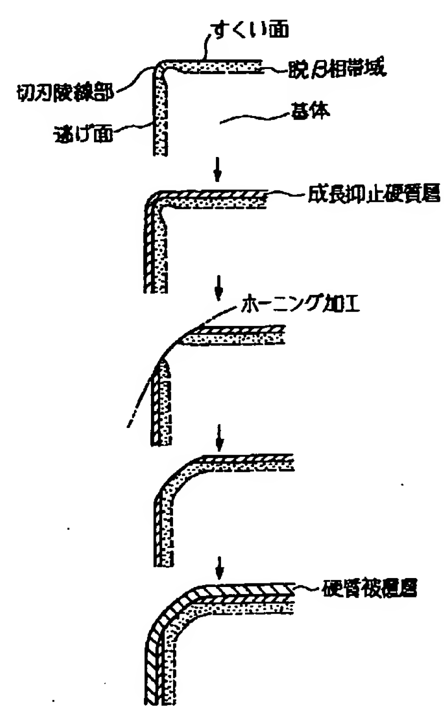
(54)【発明の名称】　耐欠損性のすぐれた表面被覆超硬合金製切削工具およびその製造法

(57)【要約】　（修正有）

【課題】　耐欠損性のすぐれた表面被覆超硬合金製切削工具の製造法およびこの方法によって製造された表面被覆超硬合金製切削工具を提供する。

【解決手段】　表面被覆超硬合金製切削工具を、（ａ）結合相形成成分：５～１５重量%、β相形成成分：１～１０重量%を含有するＷＣ基超硬合金で構成された基体を用意し、（ｂ）上記基体の表面に、前記脱β相帯域の成長抑止硬質層を化学蒸着法および／または物理蒸着法にて形成し、（ｃ）上記成長抑止硬質層形成の基体の切刃稜線部にホーニング加工を施して所定寸法とし、（ｄ）上記ホーニング加工された基体に、真空加熱処理を施して、脱窒を行って切刃稜線部だけの脱β相帯域の形成をはかり、（ｅ）上記真空加熱処理後の基体の全面に亘って、硬質被覆層を、同じく化学蒸着法および／または物理蒸着法にて形成する、以上（ａ）～（ｅ）の基本工程によって製造する。



【特許請求の範囲】

【請求項１】　Ｃｏおよび／またはＮｉを主成分とする結合相形成成分：５～１５重量％、Ｔｉ、Ｔａ、Ｎｂ、Ｚｒ、およびＨｆの窒化物および炭窒化物、並びにこれらの２種以上の固溶体のうちの１種または２種以上からなるβ相形成成分：１～１０重量％を含有する炭化タングステン基超硬合金で構成された基体の表面部に、切刃部縦断面を光学顕微鏡で観察した組織で、すくい面、すくい面と逃げ面の交わる切刃稜線部、および逃げ面にかけて実質的に同じ厚さにして、平均層厚が５～３０μｍのβ相が存在しない脱β相帯域が存在し、

また、基体表面上の切刃稜線部を除くすくい面と逃げ面には、化学蒸着法および／または物理蒸着法にて１～５μｍの平均層厚で形成された、Ｔｉ、Ｚｒ、およびＨｆの炭化物および炭窒化物のうちの１種の単層または２種以上の複層からなる脱β相帯域の成長抑止硬質層が存在し、

さらに、成長抑止硬質層および基体切刃稜線部の全面に亘って、同じく化学蒸着法および／または物理蒸着法にて形成された、Ｔｉの炭化物、窒化物、炭窒化物、炭酸化物、および炭窒酸化物、さらに酸化アルミニウムのうちの１種の単層または２種以上の複層からなる硬質被覆層が５～２０μｍの平均層厚で存在する表面被覆超硬合金で構成したことを特徴とする耐欠損性のすぐれた表面被覆超硬合金製切削工具。

【請求項２】　（ａ）　Ｃｏおよび／またはＮｉを主成分とする結合相形成成分：５～１５重量％、Ｔｉ、Ｔａ、Ｎｂ、Ｚｒ、およびＨｆの窒化物および炭窒化物、並びにこれらの２種以上の固溶体のうちの１種または２種以上からなるβ相形成成分：１～１０重量％を含有する炭化タングステン基超硬合金で構成され、かつ表面部に、切刃部縦断面を光学顕微鏡で観察した組織で、すくい面、すくい面と逃げ面の交わる切刃稜線部、および逃げ面にかけて層厚が５～３０μｍのβ相が存在しない脱β相帯域が存在する基体を用意し、

（ｂ）　上記基体の表面に、Ｔｉ、Ｚｒ、およびＨｆの炭化物および炭窒化物のうちの１種の単層または２種以上の複層からなる脱β相帯域の成長抑止硬質層を化学蒸着法および／または物理蒸着法にて１～５μｍの平均層厚で形成し、（ｃ）　上記成長抑止硬質層形成の基体の切刃稜線部にホーニング加工を施して所定寸法とし、

（ｄ）　上記ホーニング加工によって切刃稜線部の成長抑止硬質層および脱β相帯域の少くとも一部が除去された基体に、真空中、１３５０～１５００℃の温度に加熱の熱処理を施して、真空雰囲気に直接さらされる切刃稜線部での基体から真空雰囲気への脱窒を行って切刃稜線部だけの脱β相帯域の厚さ方向の形成をはかることにより、基体表面部にすくい面、切刃稜線部、および逃げ面にかけて実質的に同じ厚さにして、平均層厚が５～３０μｍの脱β相帯域を形成し、

（ｅ）　上記熱処理後の基体の全面に亘って、Ｔｉの炭化物、窒化物、炭窒化物、炭酸化物、および炭窒酸化物、さらに酸化アルミニウムのうちの１種の単層または２種以上の複層からなる硬質被覆層を、同じく化学蒸着法および／または物理蒸着法にて５～２０μｍの平均層厚で形成する、以上（ａ）～（ｅ）の基本工程からなることを特徴とする耐欠損性のすぐれた表面被覆超硬合金製切削工具の製造法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】この発明は、すぐれた耐欠損性を有し、したがって特に耐欠損性が要求される、例えば鋼の断続重切削などに用いた場合にも切刃に欠損の発生なく、すぐれた切削性能を長期に亘って発揮する表面被覆超硬合金製切削工具（以下、被覆超硬工具と云う）、およびその製造法に関するものである。

【０００２】

【従来の技術】従来、一般に被覆超硬工具が、図２の切刃部縦断面を光学顕微鏡で観察した組織による概略工程図で示される通り、（ａ）　Ｃｏおよび／またはＮｉを主成分とする結合相形成成分：５～１５重量％、Ｔｉ、Ｔａ、Ｎｂ、Ｚｒ、およびＨｆの窒化物および炭窒化物（以下、それぞれＴｉＮ、ＴａＮ、ＮｂＮ、ＺｒＮ、およびＨｆＮ、さらにＴｉＣＮ、ＴａＣＮ、ＮｂＣＮ、ＺｒＣＮ、およびＨｆＣＮで示す）、並びにこれらの２種以上の固溶体のうちの１種または２種以上からなるβ相形成成分：１～１０重量％を含有する炭化タングステン基超硬合金（以下、単に超硬合金と云う）で構成され、かつ表面部に、すくい面、すくい面と逃げ面の交わる切刃稜線部、および逃げ面にかけて層厚が５～３０μｍのβ相が存在しない、すなわち基体内部に比して硬さの低い脱β相帯域が存在する基体を用意し、（ｂ）　上記基体の切刃稜線部に、すくい面側からみた幅で０．０３～０．３ｍｍのホーニング加工を施して所定寸法とし、（ｃ）上記ホーニング加工後の基体の全面に亘って、Ｔｉの炭化物、窒化物、炭窒化物、炭酸化物、および炭窒酸化物、さらに酸化アルミニウム（以下、それぞれＴｉＣ、ＴｉＮ、ＴｉＣＮ、ＴｉＣＯ、およびＴｉＣＮＯ、さらにAl_2O_3で示す）のうちの１種の単層または２種以上の複層からなる硬質被覆層を、同じく化学蒸着法および／または物理蒸着法にて５～２０μｍの平均層厚で形成する、以上（ａ）～（ｃ）の基本工程によって製造され、またこの被覆超硬工具が、鋼や鋳鉄などの連続切削や断続切削に用いられることも知られている。

【０００３】

【発明が解決しようとする課題】一方、近年の切削装置のＦＡ化および高性能化はめざましく、かつ切削加工の省力化および省エネ化に対する要求も強く、これに伴い、切削加工は連続切削は勿論のこと、断続切削も可能

であるばかりでなく、高送りや高切り込みなどの重切削にも適用できる切削工具が求められる傾向にあるが、上記の従来被覆超硬工具においては、上記のホーニング加工で切刃稜線部の脱β相帯域の厚さ方向の一部あるいは全部が除去されるため、切刃稜線部の脱β相帯域の厚さはすくい面および逃げ面における脱β相帯域の厚さに比して相対的に薄く、あるいはこれが皆無となるため、例えばこれを鋼の断続重切削に用いた場合、特に切刃稜線部に欠けが発生し易く、実用に供することができないのが現状である。

【０００４】

【課題を解決するための手段】そこで、本発明者等は、上述のような観点から、上記の従来被覆超硬工具に着目し、これの耐欠損性向上をはかるべく研究を行った結果、被覆超硬工具を製造するに際して、図１の切刃部縦断面を光学顕微鏡で観察した組織による概略工程図で示される通り、Ｃｏおよび／またはＮｉを主成分とする結合相形成成分：５〜１５重量%、ＴｉＮ、ＴａＮ、ＮｂＮ、ＺｒＮ、およびＨｆＮ、さらにＴｉＣＮ、ＴａＣＮ、ＮｂＣＮ、ＺｒＣＮ、およびＨｆＣＮ、並びにこれらの２種以上の固溶体のうちの１種または２種以上からなるβ相形成成分：１〜１０重量%を含有する超硬合金で構成され、かつ表面部に、切刃部縦断面を光学顕微鏡で観察した組織（以下、同じ）で、すくい面、切刃稜線部、および逃げ面にかけて層厚が５〜３０μｍのβ相が存在しない、基体内部に比して硬さの低い脱β相帯域が存在する基体の表面に、あらかじめＴｉ、Ｚｒ、およびＨｆの炭化物および炭窒化物（以下、それぞれＴｉＣ、ＺｒＣ、およびＨｆＣ、さらにＴｉＣＮ、ＺｒＣＮ、およびＨｆＣＮで示す）のうちの１種の単層または２種以上の複層からなる硬質層を化学蒸着法および／または物理蒸着法にて１〜５μｍの平均層厚で形成した状態で、すくい面側からみた幅で０．０３〜０．３mmのホーニング加工を施し、このホーニング加工で切刃稜線部の上記硬質層、および同じく切刃稜線部の脱β相帯域の厚さ方向の一部あるいは全部が除去されるため、切刃稜線部の脱β相帯域の厚さはすくい面および逃げ面における脱β相帯域の厚さに比して相対的に薄く、あるいはこれが皆無となるが、これを真空雰囲気中、１３５０〜１５００℃の温度に加熱すると、切刃稜線部の基体表面部におけるβ相が分解し、これの構成成分である窒素（Ｎ）成分が真空雰囲気に放出され、これによって切刃稜線部の基体表面部における脱β相帯域の厚さ方向の形成が進行し、一方すくい面および逃げ面の表面部における脱β相帯域のさらなる厚さ方向の形成（肉厚化）は、上記ホーニング加工で除去されずに残留した上記硬質層によってＮ成分の真空雰囲気への放出が阻止されるために行われないことから、前記加熱温度に所定時間保持することによって、基体表面部にはすくい面、切刃稜線部、および逃げ面にかけて実質的に同じ厚さの脱β相帯域が形成されるようになり、この状態で、上記の硬質被覆層を、同じく化学蒸着法および／または物理蒸着法にて５〜２０μｍの平均層厚で形成すると、製造された被覆超硬工具は、基体表面部に実質的に同じ厚さで存在する脱β相帯域によってすぐれた耐欠損性を示すようになるという研究結果を得たのである。

【０００５】この発明は、上記の研究結果に基づいてなされたものであって、（ａ）　Ｃｏおよび／またはＮｉを主成分とする結合相形成成分：５〜１５重量%、ＴｉＮ、ＴａＮ、ＮｂＮ、ＺｒＮ、およびＨｆＮ、さらにＴｉＣＮ、ＴａＣＮ、ＮｂＣＮ、ＺｒＣＮ、およびＨｆＣＮ、並びにこれらの２種以上の固溶体のうちの１種または２種以上からなるβ相形成成分：１〜１０重量%を含有する超硬合金、望ましくはＣｏおよび／またはＮｉを主成分とする結合相形成成分：５〜１５重量%、ＴｉＮ、ＴａＮ、ＮｂＮ、ＺｒＮ、およびＨｆＮ、さらにＴｉＣＮ、ＴａＣＮ、ＮｂＣＮ、ＺｒＣＮ、およびＨｆＣＮ、並びにこれらの２種以上の固溶体のうちの１種または２種以上からなるβ相形成成分：１〜１０重量%を含有し、残りが炭化タングステン（以下、WCで示す）と不可避不純物からなる組成を有する超硬合金で構成され、かつ表面部に、すくい面、すくい面と逃げ面の交わる切刃稜線部、および逃げ面にかけて層厚が５〜３０μｍのβ相が存在しない、基体内部に比して硬さの低い脱β相帯域が存在する基体を用意し、（ｂ）　上記基体の表面に、ＴｉＣ、ＺｒＣ、およびＨｆＣ、さらにＴｉＣＮ、ＺｒＣＮ、およびＨｆＣＮのうちの１種の単層または２種以上の複層からなる脱β相帯域の成長抑止硬質層を化学蒸着法および／または物理蒸着法にて１〜５μｍの平均層厚で形成し、（ｃ）　上記成長抑止硬質層形成の基体の切刃稜線部にホーニング加工（通常、すくい面側からみた幅で０．０３〜０．３mm）を施して所定寸法とし、（ｄ）　上記ホーニング加工によって切刃稜線部の成長抑止硬質層および脱β相帯域の厚さ方向の少くとも一部が除去された基体に、真空中、１３５０〜１５００℃の温度に加熱の熱処理を施して、真空雰囲気に直接さらされる切刃稜線部での基体から真空雰囲気への脱窒を行って切刃稜線部だけの脱β相帯域の厚さ方向の形成をはかることにより、基体表面部にすくい面、切刃稜線部、および逃げ面にかけて実質的に同じ厚さにして、平均層厚が５〜３０μｍの脱β相帯域を形成し、（ｅ）　上記熱処理後の基体の全面に亘って、ＴｉＣ、ＴｉＮ、ＴｉＣＮ、ＴｉＣＯ、およびＴｉＣＮＯ、さらにAl_2O_3のうちの１種の単層または２種以上の複層からなる硬質被覆層を、同じく化学蒸着法および／または物理蒸着法にて５〜２０μｍの平均層厚で形成する、以上（ａ）〜（ｅ）の基本工程によって被覆超硬工具を製造する方法、並びに、上記方法によって製造された、（ａ）　Ｃｏおよび／またはＮｉを主成分とする結合相形成成分：５〜１５重量%、ＴｉＮ、ＴａＮ、ＮｂＮ、

ＺｒＮ、およびＨｆＮ、さらにＴｉＣＮ、ＴａＣＮ、ＮｂＣＮ、ＺｒＣＮ、およびＨｆＣＮ、並びにこれらの２種以上の固溶体のうちの１種または２種以上からなるβ相形成成分：１～１０重量％を含有する超硬合金、望ましくはＣｏおよび／またはＮｉを主成分とする結合相形成成分：５～１５重量％、ＴｉＮ、ＴａＮ、ＮｂＮ、ＺｒＮ、およびＨｆＮ、さらにＴｉＣＮ、ＴａＣＮ、ＮｂＣＮ、ＺｒＣＮ、およびＨｆＣＮ、並びにこれらの２種以上の固溶体のうちの１種または２種以上からなるβ相形成成分：１～１０重量％を含有し、残りがWCと不可避不純物からなる組成を有する超硬合金で構成された基体の表面部に、すくい面、切刃稜線部、および逃げ面にかけて実質的に同じ厚さにして、平均層厚が５～３０μｍのβ相が存在しない、基体内部に比して硬さの低い脱β相帯域が存在し、（ｂ）　また、基体表面上の切刃稜線部を除くすくい面と逃げ面には、化学蒸着法および／または物理蒸着法にて１～５μｍの平均層厚で形成された、ＴｉＣ、ＺｒＣ、およびＨｆＣ、さらにＴｉＣＮ、ＺｒＣＮ、およびＨｆＣＮのうちの１種の単層または２種以上の複層からなる脱β相帯域の成長抑止硬質層が存在し、（ｃ）　さらに、成長抑止硬質層および基体切刃稜線部の全面に亘って、同じく化学蒸着法および／または物理蒸着法にて形成された、ＴｉＣ、ＴｉＮ、ＴｉＣＮ、ＴｉＣＯ、およびＴｉＣＮＯ、さらにAl_2O_3のうちの１種の単層または２種以上の複層からなる硬質被覆層が５～２０μｍの平均層厚で存在する断面構造をもった被覆超硬工具、に特徴を有するものである。

【０００６】つぎに、この発明の被覆超硬工具、およびその製造法において、基体の組成、脱β相帯域、脱β相帯域の成長抑止硬質層、および硬質被覆層の平均層厚、さらに熱処理温度を上記の通りに数値限定した理由を説明する。

【０００７】（１）　基体の結合相形成成分の含有量
結合相形成成分には、焼結性を促進し、もって基体の強度を向上させる作用があるが、その含有量が５重量％未満では前記作用に所望の効果が得られず、一方その含有量が１５重量％を越えると、耐摩耗性が急激に低下するようになることから、その含有量を５～１５重量％と定めた。

【０００８】（２）　基体のβ相形成成分の含有量
β相形成成分には、基体の硬さを向上させて耐摩耗性を向上させる作用があるが、その含有量が１重量％未満では前記作用に所望の効果が得られず、一方その含有量が１０重量％を越えると、耐欠損性が低下するようになることから、その含有量を１～１０重量％と定めた。

【０００９】（３）　基体表面部の脱β相帯域の平均層厚
上記の通り脱β相帯域には、実質的にβ相が存在せず、これによって基体内部に比して相対的に低い硬さを有するようになり、耐欠損性を向上させる作用があるが、その平均層厚が５μｍ未満では、所望の耐欠損性を確保することができず、一方その平均層厚が３０μｍを越えると、基体に塑性変形が発生し易くなり、この結果切刃が偏摩耗して短時間で使用寿命に至るようになることから、その平均層厚を５～３０μｍと定めた。

【００１０】（４）　成長抑止硬質層の平均層厚
その平均層厚が１μｍ未満では、基体表面部のすくい面と逃げ面における脱β相帯域の成長抑止に所望の効果が得られず、一方前記の脱β相帯域の成長抑止効果は５μｍまでの平均層厚で十分であることから、その平均層厚を１～５μｍと定めた。

【００１１】（５）　硬質被覆層の平均層厚
その平均層厚が５μｍ未満では、所望のすぐれた耐摩耗性を確保することができず、一方その平均層厚が２０μｍを越えると、耐欠損性が低下し、切刃に欠損やチッピング（微小欠け）などが発生し易くなることから、その平均層厚を５～２０μｍと定めた。

【００１２】（６）　熱処理温度
その温度が１３５０℃未満では、切刃稜線部における脱β相帯域の形成が遅く、実用的でなく、一方その温度が１５００℃を越えると、基体が軟化し、短命化の原因となる変形を起し易くなることから、その温度を１３５０～１５００℃と定めた。

【００１３】
【発明の実施の形態】つぎに、この発明を実施例により具体的に説明する。原料粉末として、いずれも１～３μｍの範囲内の平均粒径を有するＴｉＣ粉末、ＴａＣ粉末、ＺｒＣ粉末、ＨｆＣ粉末、ＴｉＮ粉末、ＺｒＮ粉末、ＴｉＣＮ粉末、（Ｔｉ，Ｗ）Ｃ（重量比で、以下同じ、ＴｉＣ／WC＝３０／７０）粉末、（Ｔａ，Ｎｂ）Ｃ（ＴａＣ／ＮｂＣ＝９０／１０）粉末、（Ｔｉ，Ｗ）ＣＮ（ＴｉＣ／ＴｉＮ／WC＝２４／２０／５６）粉末、Ｃｏ粉末、Ｎｉ粉末、VC粉末、およびCr_3C_2粉末を用意し、これら原料粉末を表１に示される配合組成に配合し、ボールミルで７２時間湿式混合し、乾燥した後、所定形状の圧粉体にプレス成形し、この圧粉体を０．０５ｔｏｒｒの真空中、１３８０～１４５０℃の範囲内の所定温度に１時間保持の条件で真空焼結することによりＩＳＯ規格１２０４０８のスローアウエイチップ形状をもった超硬合金基体Ａ～Ｆをそれぞれ製造した。上記基体Ａ～Ｆの切刃部縦断面の光学顕微鏡写真にもとづき（以下同じ）、基体表面部の脱β相帯域の平均層厚を測定したところ、表１に示される結果を示した。

【００１４】つぎに、上記基体Ａ～Ｆの表面に、化学蒸着法を用い、通常の条件で、それぞれ表２に示される組成および平均層厚の脱β相帯域の成長抑止硬質層を形成した後、同じく表２に示される加工量のホーニング加工を施し、この時点で基体表面部の脱β相帯域の平均層厚を測定したところ表２に示される結果を示し、ついで、０．０１～０．１ｔｏｒｒの範囲内の所定の圧力の真空

中、１３７０～１４７０℃の範囲内の所定の温度に０．５～２時間の範囲内の所定の時間保持の条件で熱処理を施し、同様にこの時点でも基体表面部の脱β相帯域の平均層厚を測定したところ表３に示される結果を示し、さらに、同じく化学蒸着法を用い、通常の条件で、それぞれ表３に示される組成および平均層厚の硬質被覆層を形成することからなる本発明法１～１２を実施し、本発明被覆超硬工具１～１２をそれぞれ製造した。また、比較の目的で、表５、６に示される通り、脱β相帯域の成長抑止硬質層の形成、および脱β相帯域形成のための熱処理を行わない以外は同一の条件で従来法１～１２を行い、従来被覆超硬工具１～１２をそれぞれ製造した。　＊

＊【００１５】この結果得られた各種の被覆超硬工具について、

被削材：ＳＣＭ４３９（硬さ：Ｈｂ２３０）の角材、

切削速度：１００ｍ／ｍｉｎ、

送り：０．３７５ｍｍ／ｒｅｖ、

切り込み：３ｍｍ、

切削時間：１０分、

の条件で鋼の乾式高送り断続切削試験をおこない、切刃の逃げ面摩耗幅を測定した。この測定結果を表６に示した。

【００１６】

【表１】

種別		配合組成（重量%）			脱β相帯域の平均層厚（μｍ）		
		結合相形成成分	β相形成成分	ＷＣ	すくい面	切刃稜線部	逃げ面
基体	Ａ	Ｃｏ：６	ＴｉＣ：４，ＴａＣ：１，ＴｉＮ：１	残	７	４	８
	Ｂ	Ｃｏ：７，Cr_3C_2：０．２	ＴａＣ：３，ＺｒＣ：１，ＺｒＮ：１．５	残	２２	１８	２２
	Ｃ	Ｃｏ：８．５	ＴｉＣ：１．５，ＴａＣ：３，ＴｉＣＮ：２	残	３０	１２	３１
	Ｄ	Ｃｏ：１０，Ｎｉ：３，ＶＣ：０．１	ＴｉＣ：２，（Ｔａ，Ｎｂ）Ｃ：５，ＴｉＮ：１．５	残	１７	５	１７
	Ｅ	Ｃｏ：９	ＺｒＣ：２，ＨｆＣ：０．５，（Ｔｉ，Ｗ）ＣＮ：５	残	２５	２０	２５
	Ｆ	Ｃｏ：１３，Ｎｉ：１，Cr_3C_2：０．４	（Ｔｉ，Ｗ）Ｃ：５，（Ｔａ，Ｎｂ）Ｃ：２，ＴｉＮ：２	残	１４	６	１５

【００１７】　※

※【表２】

種別		基体記号	成長抑止硬質層の組成（括弧内は平均層厚：μm）			ホーニング加工幅（mm）		ホーニング加工後の脱β相帯域の平均層厚（μm）		
			第1層	第2層	第3層	すくい面側	逃げ面側	すくい面	切刃稜線部	逃げ面
本発明法	1	A	TiC (3)	－	－	0.04	0.03	7	1	8
	2	A	TiC (1)	ZrCN (2)	－	0.07	0.07	7	0	8
	3	B	TiCN (5)	－	－	0.15	0.04	22	0	22
	4	B	TiC (1)	HfC (1)	－	0.08	0.08	22	2	22
	5	C	HfCN (1)	TiC (3)	－	0.20	0.07	30	0	31
	6	C	ZrC (2)	HfC (1)	－	0.15	0.05	30	0	31
	7	D	TiC (2)	TiCN (1)	－	0.07	0.06	17	1	17
	8	D	TiC (0.5)	TiCN (0.5)	TiC (1)	0.06	0.08	17	3	17
	9	E	TiC (2)	－	－	0.18	0.07	25	2	25
	10	E	ZrC (1)	－	－	0.08	0.08	26	4	25
	11	F	HfCN (1.5)	－	－	0.05	0.05	14	0	15
	12	F	TiCN (2)	－	－	0.09	0.09	14	0	15

【0018】
＊　＊【表3】

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種別		熱処理後の脱β相帯域の平均層厚 (μm)			硬質被覆層 (括弧内は平均層厚：μm)						
		すくい面	切刃稜線部	逃げ面	第1層	第2層	第3層	第4層	第5層	第6層	第7層
本発明法	1	8	7	8	TiN (0. 1)	TiCN (7)	Al_2O_3 (1. 5)	TiN (0. 2)	-	-	-
	2	9	8	9	TiC (1)	TiCN (10)	TiCNO (0. 5)	Al_2O_3 (1)	TiN (0. 1)	-	-
	3	23	23	23	TiN (0. 2)	TiCN (5)	TiC (2)	TiCO (0. 5)	Al_2O_3 (2)	TiC (0. 1)	TiN (0. 1)
	4	22	21	22	TiCN (2)	TiC (1)	Al_2O_3 (0. 5)	-	-	-	-
	5	30	28	30	TiN (0. 2)	TiC (2)	TiCN (5)	TiCO (0. 5)	Al_2O_3 (3)	TiN (0. 2)	-
	6	30	27	30	TiN (0. 2)	TiCN (10)	TiCNO (0. 1)	Al_2O_3 (2)	-	-	-
	7	17	17	17	TiN (1)	TiCN (5)	TiCO (0. 2)	Al_2O_3 (5)	TiCN (0. 2)	TiN (0. 5)	-
	8	18	16	18	TiC (0. 5)	TiCN (4)	TiN (1)	Al_2O_3 (3. 5)	TiN (0. 5)	-	-
	9	25	24	25	TiCN (5)	TiC (3)	TiCO (1)	Al_2O_3 (5)	TiN (0. 1)	-	-
	10	26	24	26	TiC (3)	TiN (2)	TiC (2)	TiN (2)	-	-	-
	11	15	14	15	TiCN (2)	TiC (2)	TiCO (0. 1)	Al_2O_3 (7)	-	-	-
	12	14	14	14	TiN (0. 2)	TiCN (12)	TiCNO (0. 1)	Al_2O_3 (0. 5)	TiCN (0. 1)	TiN (0. 1)	-

【0019】　＊　＊【表4】

種別		基体記号	成長抑止硬質層の組成（括弧内は平均層厚：μm）			ホーニング加工幅（mm）		ホーニング加工後の脱β相帯域の平均層厚（μm）		
			第1層	第2層	第3層	すくい面側	逃げ面側	すくい面	切刃稜線部	逃げ面
従来法	1	A	–	–	–	0.04	0.03	7	2	8
	2	A	–	–	–	0.07	0.07	7	0	8
	3	B	–	–	–	0.15	0.04	22	0	22
	4	B	–	–	–	0.08	0.08	22	2	22
	5	C	–	–	–	0.20	0.07	30	0	31
	6	C	–	–	–	0.15	0.05	30	0	31
	7	D	–	–	–	0.07	0.06	17	1	17
	8	D	–	–	–	0.06	0.06	17	4	17
	9	E	–	–	–	0.18	0.07	25	2	25
	10	E	–	–	–	0.08	0.08	26	4	25
	11	F	–	–	–	0.05	0.05	14	0	15
	12	F	–	–	–	0.09	0.09	14	0	15

【0020】

＊ ＊【表5】

種別		熱処理後の脱β相帯域の平均層厚（μm）			硬質被覆層（括弧内は平均層厚：μm）						
		すくい面	切刃稜線部	逃げ面	第1層	第2層	第3層	第4層	第5層	第6層	第7層
従来法	1	–	–	–	TiN (0.1)	TiCN (7)	Al_2O_3 (1.5)	TiN (0.2)	–	–	–
	2	–	–	–	TiC (1)	TiCN (10)	TiCNO (0.5)	Al_2O_3 (1)	TiN (0.1)	–	–
	3	–	–	–	TiN (0.2)	TiCN (5)	TiC (2)	TiCO (0.5)	Al_2O_3 (2)	TiC (0.1)	TiN (0.1)
	4	–	–	–	TiCN (2)	TiC (1)	Al_2O_3 (0.5)	–	–	–	–
	5	–	–	–	TiN (0.2)	TiC (2)	TiCN (5)	TiCO (0.5)	Al_2O_3 (3)	TiN (0.2)	–
	6	–	–	–	TiN (0.2)	TiCN (10)	TiCNO (0.1)	Al_2O_3 (2)	–	–	–
	7	–	–	–	TiN (1)	TiCN (5)	TiCO (0.2)	Al_2O_3 (5)	TiCN (0.2)	TiN (0.5)	–
	8	–	–	–	TiC (0.5)	TiCN (4)	TiN (1)	Al_2O_3 (3.5)	TiN (0.5)	–	–
	9	–	–	–	TiCN (5)	TiC (3)	TiCO (1)	Al_2O_3 (5)	TiN (0.1)	–	–
	10	–	–	–	TiC (3)	TiN (2)	TiC (2)	TiN (2)	–	–	–
	11	–	–	–	TiCN (2)	TiC (2)	TiCO (0.1)	Al_2O_3 (7)	–	–	–
	12	–	–	–	TiN (0.2)	TiCN (12)	TiCNO (0.1)	Al_2O_3 (0.5)	TiCN (0.1)	TiN (0.1)	–

【0021】

※ ※【表6】

種別		逃げ面摩耗幅（mm）	種別		逃げ面摩耗幅（mm）
本発明被覆超硬工具	1	22.2	従来被覆超硬工具	1	3.5分で切刃欠損のため寿命
	2	24.8		2	4.2分で切刃欠損のため寿命
	3	19.7		3	2.1分で切刃欠損のため寿命
	4	15.6		4	1.9分で切刃欠損のため寿命
	5	29.8		5	5.4分で切刃欠損のため寿命
	6	26.3		6	3.0分で切刃欠損のため寿命
	7	25.2		7	4.4分で切刃欠損のため寿命
	8	21.5		8	2.9分で切刃欠損のため寿命
	9	20.5		9	1.1分で切刃欠損のため寿命
	10	21.2		10	2.3分で切刃欠損のため寿命
	11	26.8		11	5.8分で切刃欠損のため寿命
	12	28.9		12	4.6分で切刃欠損のため寿命

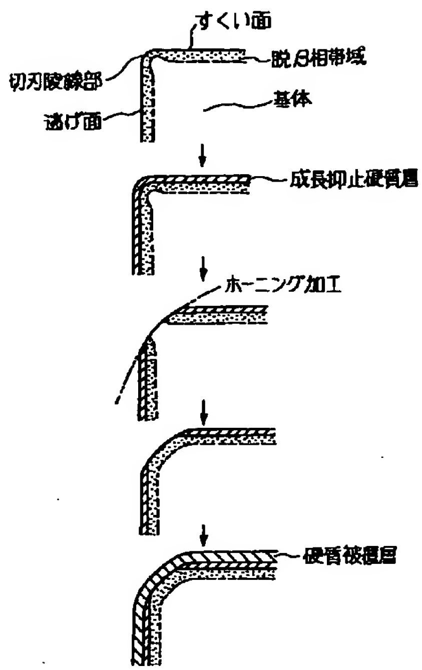
【0022】
【発明の効果】表２～６に示される通り、本発明法１～１２で製造された本発明被覆超硬工具１～１２は、いずれも基体表面部に、すくい面、切刃稜線部、および逃げ面にかけて実質的に同じ厚さの脱β相帯域が存在し、これによって鋼の高送り断続切削でも切刃に欠損の発生なく、すぐれた耐摩耗性を示すのに対して、従来法１～１２で製造された従来被覆超硬工具１～１２においては、特に基体表面部の切刃稜線部に脱β相帯域が存在せず、これが原因で上記の苛酷な条件での切削では切刃に欠損の発生が避けられず、比較的短時間で使用寿命に至るこ＊＊とが明らかである。上述のように、この発明の方法によれば、すぐれた耐摩耗性を保持した状態で、耐欠損性のすぐれた被覆超硬工具を製造することができ、したがってこの結果得られた被覆超硬工具は、通常の条件での連続切削および断続切削は勿論のこと、一段と苛酷な条件での切削となる断続切削を重切削で行っても切刃に欠損の発生なく、すぐれた切削性能を長期に亘って発揮するのである。

【図面の簡単な説明】

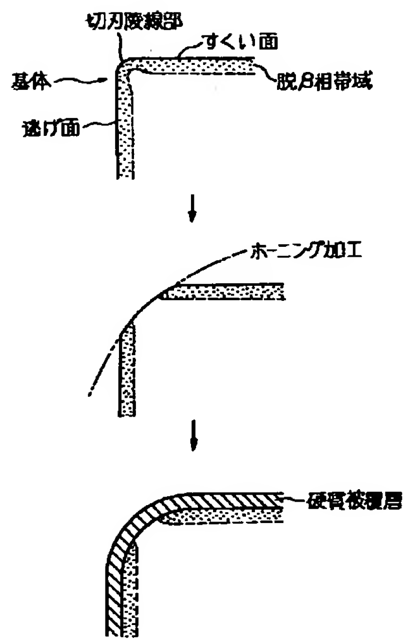
【図１】本発明方法を示す概略工程図である。

【図２】従来方法を示す概略工程図である。

【図1】



【図2】



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